

A background image of a student with long blonde hair, wearing a light-colored sweatshirt, sitting at a wooden desk in a library. She is resting her chin on her hand, looking down at a laptop. Bookshelves filled with books are visible in the background. A semi-transparent blue vertical bar is on the right side of the image.

Gaining Momentum

Technical Appendix

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tbr | THE COLLEGE SYSTEM
of TENNESSEE

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About the Data

Key Terms and Definitions

The report *Gaining Momentum: Refining Corequisite Learning Support to Boost Student Success in the First Year and Beyond* (2021) uses the definitions below to describe the success of students who were placed into corequisite learning support.

Adult students are college students who are 25+ years of age.

Corequisite learning support is the linking of learning support courses or experiences with an appropriate college-level course that is required in the student's chosen field of study so that the student is enrolled concurrently in both Learning Support and appropriate college-level courses that are applicable to the student's academic pathway.

First-time freshmen are degree-seeking students who enroll in college for the first time after graduating from high school in the fall or the prior summer and continue in the fall.

First-time, full-time freshmen are degree-seeking students who enroll in college for the first time after graduating from high school in the fall or the prior summer and continue in the fall, attempting 12 credit hours in the fall term.

Gateway courses are college-level courses that students typically take in their first year. For math, this includes all 1000-level math courses. For writing, this is English 1010. For reading, this includes courses that are paired with learning support reading. These courses differ by college and change over time but typically include English 1010, first-year seminars, or other general education courses.

Gateway course completion reflects the proportion of first-time freshmen who attempted and passed the college-level course with a grade of D or better. This is calculated as the number of students who passed the course divided by the total number of students.

Gateway course enrollment reflects the proportion of first-time freshmen who attempted a college-level gateway course in the subject area.

Gateway course pass rates reflect the proportion of first-time freshmen who passed the college-level course with a grade of D or better. This is calculated as the number of students who passed the course divided by the number of students who attempted the course.

Graduation rates reflect the proportion of first-time, full-time students who earned a credential at any TBR community college within three years of first enrolling.

Learning support is the academic support needed by a student to succeed in college-level general education courses. The purpose of learning support is to enhance academic success in college-level courses and increase the likelihood of program completion that will prepare students for career success in their chosen field of study.

Learning support placement is based upon students' scores on assessment methods like the ACT, ACCUPLACER, SAT, or completion of SAILS competencies.

Low-income students are defined as students who received a Pell Grant in their first term of enrollment as first-time freshmen. Acknowledging that this is an imperfect measure, the trends here may be underreported as not all low-income students are Pell grant recipients ([Delisle, 2017](#)). Data on Pell Grant recipients are unavailable before fall 2015.

Recent high school graduates enroll in college for the first time within one calendar year of high school graduation.

Retention rates reflect the proportion of first-time freshmen who returned as a student at any TBR community the following spring or fall or earned a degree or certificate before the start of the following spring or fall.

About the Sample

The primary data analysis in *Gaining Momentum: Refining Corequisite Learning Support to Boost Student Success in the First Year and Beyond* (2021) relies upon an analytic sample of 162,238 students who enrolled at community colleges in the fall 2013 to fall 2019 cohorts (except where otherwise noted). The table below describes the characteristics of this sample.

Table 1: Analytic Sample, First-Time Freshmen at Tennessee Community Colleges from 2013 to 2019

	Number	Percent of Total
Asian	2,508	2%
Black or African American	28,790	18%
Hispanic	10,447	6%
White	112,711	69%
All Other Races/Ethnicities	7,782	5%
Female	92,328	57%
Male	69,897	43%
Recent High School Graduates	127,868	78%
Adult Students	15,772	10%
Placed into Learning Support Math	78,382	48%
Placed into Learning Support Reading	54,846	34%
Placed into Learning Support Writing	59,351	37%
All Students	162,238	

Additional analyses focus exclusively on the 2015 to 2019 cohorts of first-time freshmen. The table below describes the characteristics of this narrower sample.

Table 2: Analytic Sample, First-Time Freshmen at Tennessee Community Colleges from 2015 to 2019

	Number	Percent of Total
Asian	1,936	2%
Black or African American	21,620	17%
Hispanic	8,815	7%
White	87,270	69%
All Other Races/Ethnicities	6,242	5%
Female	71,668	57%
Male	54,177	43%
Recent High School Graduates	102,076	81%
Adult Students	11,073	9%
Placed into Learning Support Math	56,133	48%
Placed into Learning Support Reading	42,459	34%
Placed into Learning Support Writing	45,867	36%
All Students	125,883	

In each sample, learning support placement is defined based upon the subjects for which students qualify for support, not actual enrollments in learning support. Comparisons between learning support and other students were made at the subject-level without respect to other placements.

SAILS completers were generally included in this analysis alongside students who did not require learning support, except where noted otherwise. Although SAILS students were placed into and received math learning support during their high school senior

year, SAILS completers were not required to complete learning support upon enrolling as first-time freshmen. This distinction reflects a change from how TBR has traditionally reported learning support placement rates.

The dataset for this analysis uses the end-of-term enrollment and course data to explore outcomes for first-time freshmen. Student outcomes were analyzed at the conclusion of the student's first academic year as a first-time freshman, including the preceding summer, fall, spring, and trailing summer, as well as any known prior credit from dual enrollment at community colleges.

The analysis primarily focuses on student outcomes in credit-bearing, college-level courses rather than outcomes in learning support sections. In most cases, learning support students who complete the college-level gateway course were considered to have fulfilled their learning support requirements, even if they did not pass the learning support course. Therefore, this analysis focuses on outcomes in gateway courses rather than outcomes in learning support courses.

About the Data Analysis

Improving Gateway Course Completion in Math, Reading, & Writing

The first section of the *Gaining Momentum* report focuses on improving placement accuracy. This section includes descriptive analyses of gateway course completion rates for learning support and non-learning support students by ACT subject scores and cumulative high school GPA on a 4.0 scale. Since descriptive analyses may obscure some differences in outcomes across student groups or the impact of other factors that influence course success, this section also describes results from other methods to estimate the impact of corequisite learning support.

For the regression discontinuity and difference-in-difference estimations, the sample included first-time freshmen who enrolled at Tennessee community colleges from the fall 2013 to fall 2019 cohorts. After dropping a subset of students for whom some data was missing, the sample size included 108,081 students. The sample excluded students who completed a corequisite course during corequisite pilots in 2014-2015. Additionally, students who completed a prerequisite learning support course after 2015 (due to delayed scaling of corequisite reforms at some colleges) were also excluded.

The primary outcome of interest in each of these models was gateway course success, a binary measure of a student's course enrollment resulting in a passing grade (e.g., a grade of A, B, C, or D, etc.). Logit estimations were calculated with fixed effects for college and term. Models were estimated separately for each learning support subject area. Predicted probabilities were calculated with all other variables set at their mean value. Each model includes a set of control variables for a student's demographic and academic characteristics. First, each model includes controls for student demographic characteristics during their first-time freshmen term. This includes the student's gender, race/ethnicity, and age. Additionally, each model includes controls for students' academic characteristics, such as whether the student was enrolled full-time in the first term, high school GPA, ACT subject scores, and learning support placement.

Promoting Access & Success through Accuracy in Learning Support Placement

The second section of the *Gaining Momentum* report focuses on improving gateway course completion. This section includes descriptive analyses of gateway course completion rates for learning support and non-learning support students based on their ACT subject scores and cumulative high school GPA on a 4.0 scale. Additionally, building upon prior research on predictive analytics and placement algorithms (like [Bergman et al., 2020](#)), we built a hypothetical placement instrument based on data from community college students' outcomes. This instrument used data about students' standardized test scores and high school GPAs and accounted for students' first-semester enrollment characteristics and college of enrollment. Then, we compared the predictions of this instrument to actual student placement and outcomes from first-time freshmen at Tennessee community colleges from the fall 2015 to fall 2019 cohorts. Models were estimated separately for each subject area where learning support is provided.

The sample for this analysis included first-time freshmen who enrolled at Tennessee community colleges from the fall 2015 to fall 2019 cohorts. For this analysis, we limited the sample to students who enrolled within one year of high school graduation and who enrolled in gateway courses in their first year. These models included students who were placed into learning support as well as non-learning support students. Students who completed SAILS were excluded from this portion of the analysis. After dropping a subset of students for whom some data was missing, the sample size included 86,460 students.

In each model, the primary outcome of interest was gateway course success, a binary measure of a student's course enrollment resulting in a passing grade (e.g., a grade of A, B, C, or D, etc.). Estimations were calculated with fixed effects for college and term. Predicted probabilities were calculated with all other variables set at their mean value. Each model includes a set of variables for a student's whether the student was enrolled full-time in the first term.

We tested a series of logistic regression models that estimated the probability that a student would earn a passing grade in gateway math, reading, and writing courses by the end of their first year of enrollment. To understand the factors that predict course success, we tested three types of models for each subject:

- Model A estimated students' probability of passing a gateway course based on the college of enrollment, term of enrollment, and full-time status. No measures of preparation were included.
- Model B added ACT subject scores to the model in Model A.
- Model C added students' high school GPAs.

To evaluate these models, we identified two types of metrics:

- 1) First, we identified whether adding or removing new measures of academic preparation increased or decreased the overall predictive power of the model. We call this the *model fit*. Model fit was measured using the BIC (Bayesian Information Criterion), which describes the overall fit of a model. The model with the smaller BIC is the better model. When comparing two models, a difference of ten or more suggests evidence of very strong improvement in model fit.
- 2) Second, we calculated how well the model's predictions of student success compared to actual outcomes observed among students. We will call this the *model accuracy*. Model accuracy was calculated using a postestimation classification table that calculates the rate at which a model correctly predicted real outcomes. For estimates of model accuracy, the threshold of success was set at 0.70, the mean probability of passing a course.

Supporting Institutional Innovation & Autonomy

The third section of the *Gaining Momentum* report explores the impact of different models of corequisite learning support. This includes descriptive data analyses of course completion rates, retention rates, and graduation rates based upon the characteristics of course sections in which students enrolled. However, because descriptive analyses may obscure some differences in outcomes across student groups or the impact of other factors that influence success, this section also describes the results of other analysis methods to estimate the impact of various corequisite models.

The sample for these analyses included first-time freshmen who enrolled at Tennessee community colleges from the fall 2015 to fall 2019 cohorts. The sample included students who were placed into learning support and who enrolled in a learning support course and a paired-college level course within their first year of enrollment. Students who completed SAILS were excluded from this portion of the analysis. Additionally, students who completed a prerequisite learning support course after 2015 (due to delayed scaling of corequisite reforms at some colleges) were also excluded.

In the first set of models, the primary outcome of interest was gateway course success, a binary measure of a student's course enrollment resulting in a passing grade (e.g., a grade of A, B, C, or D, etc.). In the second set of models, the primary outcome of interest was retention, a binary measure of whether the students persisted to the following fall semester or graduated prior to the start of the fall semester. The third outcome of interest was graduation, a binary measure of whether the students graduated from any Tennessee community college within three years of first enrolling. Logit estimations were calculated with fixed effects for term of enrollment. Models were estimated separately for each learning support subject area. Predicted probabilities were calculated with all other variables set at their mean value. Each model includes a set of control variables for a student's demographic and academic characteristics. First, each model includes controls for student demographic characteristics during their first-time freshmen term. This includes the student's gender, race/ethnicity, and age. Additionally, each model includes controls for students' academic characteristics, such as whether the student was enrolled full-time in the first term, high school GPA, and ACT subject scores.